Department of Energy

Washington, DC 20585

MAR 2 2005

Dr. William C. Louis
P Division, H646
Los Alamos National Laboratory
P.O. Box 1663
Los Alamos, NM 87545

Dear Dr. Louis:

Enclosed are two documents, the Department of Energy Report of the Annual Technical Progress Review of the np→dγ Experiment at Los Alamos National Laboratory on October 6-8, 2004, and a Review Excerpts document from that review.

The findings of the review indicate that the planned scientific program continues to have scientific merit, albeit with reduced sensitivity. Significant technical accomplishments have occurred in the past year with the completion of the beam-line project and majority of work elements in the experiment project. Technical and schedule challenges remain with the installation and commissioning of the critical path liquid hydrogen target which is jeopardizing the possibility of making a scientific measurement prior to the end of FY 2006. Significant management oversight and strong collaboration participation will be imperative to bring this effort to a successful conclusion. Thank you for your preliminary response to the review submitted in January 2005. Please make any necessary updates to your response in the context of this final report and submit by April 1, 2005.

The project's members are thanked for their efforts in preparation for the review and it is hoped that the findings and recommendations of the review team will be helpful.

Sincerely,

Jehanne Simon-Gillo
Acting Director
Facility and Project Management Division
Office of Nuclear Physics

Enclosures

cc: Seppo Pentilla, LANL
David Bowman, LANL
Brad Keister, NSF

Department of Energy
Office of Nuclear Physics Report

on the

Annual Technical Progress Review

of the

LANL $n + p \rightarrow d + \gamma$ Experiment

October 6-8, 2004

Executive Summary

The Department of Energy (DOE) Office of Nuclear Physics (ONP) held an Annual Technical Progress Review of the np→dγ Experiment at Los Alamos National Laboratory (LANL) on October 6-8, 2004.

This experiment proposes to measure the parity-violating asymmetry of the correlation between the direction of emission of the gamma ray and the neutron polarization in the reaction np→dγ. Nuclear parity violation probes the hadronic weak interaction short-range correlations between quarks. A precise measurement of gamma-ray asymmetry of polarized neutron capture on para-hydrogen at the level of sensitivity of 5×10^{-9} should resolve the current experimental disagreement on the value of the πNN coupling constant, f_π as well as provide important guidance on the weak NN meson-exchange process.

The project is separated into two efforts, the experiment construction and the beam line construction at the LANSCE facility at LANL. David Bowman is the spokesperson of the experiment and Seppo Pentilla is the Project Manager. The agreed upon DOE funding profile is as follows:

	Prior Yrs	FY01	FY02	FY03
Beamline:	205	1200	503	0
Experiment:	83	736	399	98

All capital equipment funds have been allocated.

Summary of Primary Findings

The LANL np→dγ collaboration estimates that the measurement at LANSCE will have nearly a factor of 10 less sensitivity than stated in the original proposal. Although the expected result would lack the precision to resolve disagreement between existing measurements, the measurement would still constitute interesting physics potentially yielding a factor of four improvment over the best existing measurement world-wide. The committee urged the LANL np→dγ collaboration to focus on completing a measurement at LANSCE by the end of FY 2006 and then consider moving the apparatus to the Fundamental Neutron Physics Beam-Line at the Spallation Neutron Source, where higher neutron fluxes would be available.

The collaboration and project management was congratulated on completing the fabrication of the beam-line. All work components of the experiment project have been completed with the exception of the installation and commissioning of the liquid hydrogen target, which has substantial safety hurdles to overcome. This could seriously compromise the ability of the collaboration to complete a first physics measurement during the 2005 beam cycle. The proposed schedule to install and operate the LH_2 target in the beam line has zero float and was presented as an "optimistic" schedule. The completion of the target will require significant management oversight and collaboration

participation to complete successfully. The panel recommended that Physics Division and LANSCE management play a stronger role in the development and implementation of the target completion plans.

The experiment has essentially expended the allocated DOE funds. An additional $220k is needed to complete the fabrication of the experiment which will be covered by internal LANL funding (LDRD).

The collaboration had a productive commissioning run in 2004 of existing components. A run plan for the commissioning of the target and operations of the experiment was not presented. The committee recommended that the collaboration develop a detailed run plan for commissioning and experimental operations, and a clear strategy for carrying out the analysis of the data.

CONTENTS

Introduction

On October 6-8th, the DOE Office of Nuclear Physics (ONP) held an Annual Technical Progress Review of the LANL np→dγ Experiment at Los Alamos National Laboratory. The review committee consisted of five external consultants: Professor Robert Tribble (Texas A&M University), Professor Christopher Gould (North Carolina State University), Professor Fred Wietfeldt (Tulane University) and Professor John Wilkerson (University of Washington). Dr. Jehanne Simon-Gillo of the ONP chaired the review and Gene Henry of the ONP also participated. This review was considered necessary by ONP in order to regularly assess the overall status of the ongoing project.

In order to perform the review, each panel member was asked to evaluate and comment on any relevant aspect of the LANL np→dγ Experiment. However, the focus of the np→dγ annual progress review was on understanding:

- The merit and significance of the currently proposed experimental programs;
- The technical status of the neutron projects;
- The feasibility and completeness of the budgets and schedules;
- The effectiveness of the management structures;
- Plans for commissioning and operation; and
- Other issues related to the neutron experiments and their experimental program.

The review was based on formal presentations given by np→dγ project staff, detailed discussions with np→dγ staff, and the panel members' extensive experience. The first day was devoted to presentations given by npdγ staff. These presentations provided an overview and response to the charge letter. The second day included a tour of the experiment, a Q&A session in which np→dγ staff presented answers to homework assigned by the panel the previous evening, and panel deliberations. The panel held a closed panel session with upper management and presented a closeout briefing on October 8th. The detailed agenda is included in Appendix B.

DOE Recommendations

- The collaboration should make the best achievable measurement at LANSCE to learn as much as possible about the apparatus and obtain a first physics result.

- Develop a detailed run plan for commissioning and experimental operations, and a clear strategy for carrying out the analysis of the data.

- A run coordinator should be identified for the upcoming run.

- An analysis coordinator should be appointed in the near future.

- P Division should work with LANSCE division management and the experiment project management to generate an agreed upon plan detailing the steps that need to be taken for the installation and commissioning of the target as soon as possible during the 2005 run cycle. This plan should be submitted to DOE.

Scientific Program

Findings:

This project has been supported by DOE for over five years and has experienced significant delays and cost overruns relative to the original proposal. Experiments that probe the hadronic weak interaction are challenging and progress in this field has been slow. The measurement that this collaboration plans will probe a particular part of the interaction, the pion exchange, or f_π, term. There are conflicting results for f_π from two different measurements. The measurement of the asymmetry, A_γ, in $n + p \rightarrow d + \gamma$ at the originally proposed level would clear up this discrepancy. But the measurement at LANSCE has been compromised by several factors and the sensitivity that can be reached in the near future will likely not be definitive. The experiment will need to move to a cold neutron beam line that will be able to produce significantly higher flux in order to attain the sensitivity close to that projected in the original proposal. But it is critical that the experiment attain first results at LANL in order to verify that there are no other problems with it than achieving the required neutron flux.

Based on the performance of the apparatus during the commissioning run, an uncertainty of 5×10^{-8} in A_γ can be expected with approximately 1000 hours of beam at FP-12 with the LH_2 target.

Comments:

The scientific motivation for a measurement of A_γ at the originally proposed sensitivity of 5×10^{-9} was very strong. It has not diminished since the np→dγ experiment was first proposed. A measurement of A_γ at the new FP-12 benchmark of 5×10^{-8} is unlikely to constrain f_π at an interesting level (unless it is quite large). However it would improve on the previous best measurement at the ILL and so would be publishable as a physics result. It would also be an important stepping stone, in terms of testing the full apparatus and understanding systematic effects, for an ultimate 5×10^{-9} measurement at a brighter source such as the SNS FNPB.

Recommendations:

- The collaboration should make the best achievable measurement at LANSCE to learn as much as possible about the apparatus and obtain a first physics result.

Technical Status

Findings:

The committee found that the beam line project has been successfully completed, albeit with reduced neutron beam intensity compared to the initial proposal.

The commissioning run in 2004 was very successful, and succeeded in testing all components with the important exception of the hydrogen target itself. The field from the magnet on neighboring beam line FP11 was found to exceed the proposed specifications even after substantial efforts in building active and passive shielding.

The hydrogen target installation has experienced significant delays. The target vessel, the refrigerators, and the gas manifold systems have been tested with LN2 and were delivered to LANSCE in 2003. However, the target has never been filled with liquid hydrogen and the safety review schedule for moving forward has not been defined.

Comments:

The collaboration was congratulated on the performance of the beam-line hardware and detector components, and for their skills in bringing to completion the construction of a detector with exceptional capabilities for measuring asymmetries with unprecedented precision.

The impact of the field from the neighboring magnet, given the installation of the bucking coils and shielding, appears to be acceptable for the first phase of the experiment with the expected statistical sensitivity.

Recommendations:

- None

Budget and Schedule

Findings:

The project is separated into two components, the fabrication of the experimental set-up and the fabrication of the beam-line. Nearly all of the work packages have now been completed. The beam-line project is complete. The collaboration is to be congratulated for the substantial progress demonstrated in successfully commissioning these systems. It is noted that for the majority of these work packages, the date of completion occurred 12-16 months later than forecast.

The critical LH_2 target work package remains to be completed. This could seriously compromise the ability of the collaboration to complete a first physics measurement during the 2005 beam cycle. The project schedule continues to slip. The proposed schedule to install and operate the LH_2 target in the beam line has zero float and was presented as an "optimistic" schedule.

A detailed and thorough run plan was not presented.

The experiment has essentially expended the allocated DOE funds. An additional $220k is needed to complete the fabrication of the experiment. This cost overrun will be covered by internal LANL funding (LDRD).

Comments:

Unrealistic schedules that result in schedule slippages are unacceptable. The committee believed that the presented schedule to complete project activities was not realistic. A more likely schedule would be for the collaboration to attempt to successfully commission the target before the end of the 2005 run, and plan on a dedicated physics run during the 2006 cycle. This would possibly allow the collaboration to negotiate with LANSCE on the operation of the FP11 magnet. A best case scenario might then be that the FP11 magnet would not be turned on during the first half of the 2006 run cycle.

The collaboration needs to be involved in the development of realistic schedules. Physics Division management should also perform an internal review of proposed schedules before they are presented to external review committees.

There are related serious coordination issues between LANSCE and P Divisions that must be addressed in a timely fashion in order to complete the hydrogen target package. The mechanisms and people needed to complete this effort were not apparent.

The collaboration needs to focus on moving from construction to operations. The collaboration should develop a detailed run plan that includes careful consideration of any potential systematic studies. The plan should be developed well ahead of the scheduled run. It should be a "living" document that is being continually reviewed and updated by the collaboration.

Recommendations:

- Develop a detailed run plan for commissioning and experimental operations, and a clear strategy for carrying out the analysis of the data.

Management and Commissioning Plans

Findings:

Project management was congratulated for the successful commissioning run carried out in 2004. Collaborating institutions have made substantial contributions to instrumentation and intellectual leadership.

Unfortunately, projected milestones continue to slip, sometimes for circumstances beyond the control of the project, such as a LANL-wide shutdown. However, the project management put forward what was believed to be an unrealistic schedule for installing and commissioning the LH_2 target.

An up-to-date plan identifying the personnel needed to carry out the upcoming commissioning and data run was not presented.

Comments:

The continued efforts of collaborating institutions will be critical for the success of the experiment. The committee was concerned that the management team may not be speaking for the collaboration on issues of scheduling and the future of the experiment. The focus for some time appears to have been on moving the experiment to HFIR rather than exploiting the opportunities at LANSCE.

The project has lost a number of key players recently. No plan for how to replace these individuals was provided. The collaboration should address the manpower issues and assess if they have sufficient people available to carry out the program. The collaboration should consider the management structure that is now in place and assess if changes may be needed for the future as the project becomes an experiment.

It is imperative that Physics Division and LANSCE management work closely with the project management to make sure that the experiment comes to fruition. This will be necessary in order to ensure a meaningful return of investment and to maintain credibility with the funding agencies.

Given the present status of the experiment, the committee believed it likely that the experiment would not be complete until the end of the 2006 run cycle. Following the completion of the measurement at LANSCE, it may be advantageous for the experiment to consider a move to the SNS, where it would likely be the first experiment to run on the new nuclear physics beam-line. The experiment would be well situated to carry out measurements of both $np \rightarrow d\gamma$ and $nd \rightarrow t\gamma$. This would make it a very attractive experiment for people to join who are interested in the neutron program at the SNS.

Recommendations:

- A run coordinator should be identified for the upcoming run.

- An analysis coordinator should be appointed in the near future.
- P Division should work with LANSCE division management and the experiment project management to generate an agreed upon plan detailing the steps that need to be taken for the installation and commissioning of the target as soon as possible during the 2005 run cycle. This plan should be submitted to DOE.

Appendix A
Charge Memorandum

Thank you for agreeing to participate as a review committee member for the annual technical progress reviews of the Los Alamos National Laboratory (LANL) neutron experiments, $n + p \rightarrow D + \gamma$ and UCN Beta Asymmetry. These progress reviews are scheduled for October 6-8, 2004, in Los Alamos, New Mexico. A list of the members of the review panel and anticipated Department of Energy (DOE) participants is enclosed.

Each committee member is being asked to evaluate and comment on any relevant aspect of both of the neutron experiments. However, the focus of these annual progress reviews will be on understanding:

- The merit and significance of the currently proposed experimental programs;
- The technical status of the neutron projects;
- The feasibility and completeness of the budgets and schedules;
- The effectiveness of the management structures;
- Plans for commissioning and operation;
- Other issues related to the neutron experiments and their experimental program.

Each committee member is asked to review these aspects of the neutron experiments and write an individual "letter report" on his findings. These "letter reports" will be due at DOE on October 22nd. I will chair the committee and will accumulate the "letter reports" and compose a final summary report based on the information in the letters.

We take care to keep the identity of the reviewers confidential in the summary report. It would be convenient if you would prepare your response in a form suitable for transmittal to the proponents devoid of potentially identifying information. The cover letter may include other remarks you wish to add.

The Laboratory has been asked to provide relevant background materials prior to the review. This documentation, along with a current agenda, will be distributed in the near future. If you have any questions about the review, please contact me at (301) 903-1455, or E-mail: Jehanne.Simon-Gillo@science.doe.gov. If you have any questions regarding local travel or lodging, please contact Beatrice Romero at (505) 667-4117, or E-mail: bromero@lanl.gov.

I greatly appreciate your willingness to assist us in this review. I look forward to very informative and stimulating reviews at LANL.

Sincerely,
Jehanne Simon-Gillo
Acting Director
Facilities and Project Management Division
Office of Nuclear Physics

Appendix B
Agenda

Wednesday, October 6 - NPDGamma Review

7:40 AM	Pick up visitors and get badges
8:20	Executive committee meeting (closed session)
8:50	Management Perspective (Physics Division & LANSCE Division)
9:15	Overview for npdg - scientific goals, progress, results, plans - David (45'+15')
10:15	Break
10:35	Experiment and beamline - status, results, plans - Scott (45'+15')
11:35	LH2 target - status, safety, plans - Mike (25'+15')
12:15 PM	Working lunch
1:15	Visit ER2 and LH2 target
2:00	Plans to complete the project and run plan '05 - Chupp (30'+15')
2:45	Break
3:05	Project management - status, cost, schedule - Seppo (25'+20')
3:50	Proposal for production run at HFIR - David/Ito (15'+10')
4:15	Executive committee meeting (closed session)
	Homework assignments provided to npdg by committee

Thursday, October 7

7:30 AM	Pick up visitors
8:00	npdg homework report/executive committee meeting (closed session)
9:00	UCNA review starts

Friday, October 8 - Closeout

7:30 AM	Pick up visitors
8:00	UCN homework report
8:30	"Possible Discussion with Physics & LANSCE Division management"
9:00	Executive committee meeting (closed session)
12:00 PM	Working lunch
1:30	Verbal closeout
2:00	Review Ends

Department of Energy
Office of Nuclear Physics

Reviewer Excerpts from the

Annual Technical Progress Review

of the

LANL $n + p \rightarrow d + \gamma$ Experiment

October 6-8, 2004

EXCERPTS FROM PANEL MEMBER REPORTS

The Annual Technical Progress Review of the Los Alamos National Laboratory (LANL) $n + p \rightarrow D + \gamma$ experiment was held at LANL on October 6-8, 2004. Excerpts from the reports of the review panel members regarding these findings as well as others are provided below in their responses to the review criteria they were asked to address.

The merit and significance of the currently proposed experimental programs:

Reviewer:

This project has been underway now for some time at LANL. It has suffered significant delays and cost overruns relative to the original proposal. Nevertheless, the science that this project is probing – the hadronic weak interaction – remains very interesting. Little progress has been made in this field in the last decade largely because experiments that can probe the hadronic weak interaction are typically very difficult to perform. The measurement that this collaboration plans will probe a particular part of the interaction, the pion exchange, or f_π, term. There are conflicting results for f_π from two different measurements. The measurement of the asymmetry, A_γ, in $n + p \rightarrow d + \gamma$ at the originally proposed level would clear up this discrepancy. But the measurement at LANSCE has been compromised by several factors and the sensitivity that can be reached in the near future will likely not be definitive. The experiment will need to move to a cold neutron beam line that will be able to produce significantly higher flux in order to attain the sensitivity close to that projected in the original proposal. But it is critical that the experiment attain first results at LANL in order to verify that there are no other problems with it than achieving the required neutron flux.

Reviewer:

The scientific motivation for a measurement of A_γ at the originally proposed sensitivity of 5×10^{-9} is very strong. It has not diminished since the $np \rightarrow d\gamma$ experiment was first proposed. It would provide an unambiguous determination of the isovector PNC hadronic weak coupling f_π at a theoretically interesting level and resolve the discrepancy between the ^{18}F gamma ray and ^{133}Cs nuclear anapole experiments. Unfortunately the moderator brightness, proton current, and neutron guide transmission are all lower than originally estimated. Consequently the collaboration believes the best measurement of A_γ that can be made at LANSCE FP-12 will have a statistical uncertainty (1 sigma) of 5×10^{-8}, a factor of ten larger than proposed. Based on the performance of the apparatus during the commissioning run, and the anticipated performance of the LH_2 target, it is realistic to expect that this goal can be achieved with 1000 hours of beam. A measurement at this level is unlikely to constrain f_π at an interesting level (unless it is quite large). However it would improve on the previous best measurement at the ILL by Caviagnac *et al.* (1977) and so would be publishable as a physics result. It would also be an important stepping stone, in terms of testing the full apparatus and understanding systematic effects, for an ultimate 5×10^{-9} measurement at a brighter source such as the SNS Fundamental Neutron Physics Beam-line.

Reviewer:

Despite lengthy delays and a loss of a factor of ten in expected sensitivity, the experiment is still of compelling interest. It's critical that the collaboration hold together and follow through to complete the first series of measurements of f_π at LANSCE, this run cycle, or more likely the next. There could still be a surprise if f_π is (really) large, say of order 10 x 10^{-7}, at the upper end of the DDH range. Most likely it isn't, and they will only set an upper bound of 4 or 5 x10^{-7}. Even that will be useful. For the first time we will have a model independent limit. Importantly, the groundwork will have been laid for a move to the SNS in 06 or 07, where the full precision of the apparatus can be exploited. The capability to do this measurement at the originally proposed precision will exist at SNS and nowhere else in the world.

Reviewer:

Nuclear parity violation probes the hadronic weak interaction short-range correlations between quarks. A precise measurement of gamma-ray asymmetry of polarized neutron capture on para-hydrogen at the level of sensitivity of 5 x 10^{-9} should resolve the current experimental disagreement on the value of the πNN coupling constant, f_π as well as provide important guidance on the weak NN meson-exchange process.

The LANL npdγ collaboration now forecasts that their measurement at LANSCE will have nearly a factor of 10 less sensitivity then originally projected in their proposal. Thus it is unlikely they can clearly resolve the above question, but their measurement would still constitute interesting physics potentially yielding a factor of four improvement over the previous best measurement from the ILL.

The collaboration emphasized that they would like to move their program to the HIFR reactor, where they believe they can obtain sufficient neutron flux to attain their original sensitivity goal. Such a move is not merited based on the collaboration's performance record to date. It is imperative that the collaboration focus on making a careful measurement at LANSCE to demonstrate the capabilities of their apparatus and to characterize potential systematic effects. The collaboration originally argued strongly that doing this measurement at a pulsed spallation neutron source was vital to characterizing systematic effects. In considering a future reactor based measurement will need to demonstrate why this would no longer be necessary.

The technical status of the neutron projects:

Reviewer:

The project is nearly complete. The missing item is the LH_2 target which is now at LANL. The target has not been tested with H_2 nor has it had undergone the requisite safety reviews that will be necessary before it can be moved into the beam line. The

steps outlined to complete this part of the project were: (1) get approval to carry out tests in a temporary location to verify target operation with LH_2 (to date the target has not been tested with LH_2); (2) train operators to use the target; (3) make modifications to experimental area to satisfy safety requirements; (4) obtain approval to operate the target in the beam. Given the present status of LANL and the P-division, it seems unlikely that all of these steps will be completed in time to carry out a long run with the target during the '05 run cycle. It is absolutely critical for the team to run the target long enough during this next running period to be prepared to take data during the '06 period. If this is not accomplished, the project will be severely compromised.

The beam line was commissioned several years ago. It was discovered during the commissioning run that the flux from the line was about 50% of what had been originally expected. Following more careful calculations using the as built geometry, the measured flux was about 2/3 of the estimate. This discrepancy remains unsolved. This flux loss, coupled with a factor of two lower proton beam current than had been assumed, accounts for a part of the lost sensitivity.

A problem that was encountered during the beam line commissioning was magnetic field in the apparatus from a nearby superconducting solenoid magnet. When the solenoid was activated, it produced large fields in the area of the target. Very low magnetic fields off the beam axis are required to generate the high polarization needed for this experiment. In order to reduce the effects of the solenoid, an active shield consisting of an iron box with compensating coils was built around the experiment. The shielding significantly reduced the bothersome field components in the area of the target. But it would still be very difficult to run the experiment while the superconducting magnet was in use. An administrative agreement was reached that the two beam lines would share the time so that the asymmetry measurement could be carried out without changing fields. But operating the superconducting magnet causes the iron shield to become magnetized and hence leads to a field in the target region. The magnetization decays over a period of time. It can be partly compensated with the coils used to produce a holding field in the target area. While not adequate for the original goal, it appears that the stray field is not a major problem for the new goal of an asymmetry measurement a factor of 10 less sensitive than the original proposal as long as the superconducting magnet is off. An administrative 'solution' to the magnetic field problem was to share the beam time between the two beam lines. This results in another factor of two loss in sensitivity due to fewer beam hours. Clearly it will be crucial to control stray magnetic fields in the vicinity of the target from the outset at a future location for the experiment.

The neutron polarizer, analyzer and detection system have been tested in the neutron hall with a neutron beam. The various detector elements appear to be working close to the original specifications. Several asymmetries were measured during the past beam period using solid targets. These measurements both demonstrated that the system is working and provided data for understanding backgrounds due to detector and target materials. The runs were carried out during a relatively short time. It will be critical during the next run cycle to have enough running time to determine the long term stability of the system components.

Reviewer:

The beam line portion of this project is now complete. A pulsed cold neutron beam suitable for the reduced-sensitivity measurement has been delivered to the experimental cave at FP-12.

All components of the experimental apparatus have been constructed and, with the exception of the LH_2 target, are essentially ready to begin the measurement. A very successful commissioning run was conducted February–April 2004. The neutron beam, ^{3}He polarizer, RF spin flipper, CsI detector array, detector electronics, and data acquisition system performed well with only minor problems. The collaboration noted some work needed to improve performance of the ^{3}He polarizer, beam chopper electronics, detector electronics, and the target motion system prior to the physics measurement. Plans for this work appear to be sound and feasible. The parity-violating asymmetry A_γ using a chlorine target was successfully measured as a test of the full apparatus. Background asymmetries from construction and shielding materials were shown to be small.

The large (7%) detector background current observed during the test run is a potential cause for concern. It was attributed to neutron activation of the detectors and other materials, in which case it may become worse when a longer run is attempted. Additional ^{6}Li shielding around the target and other beam line components can reduce this problem.

The residual field from the nearby FP-11 magnet continues to exceed the desired specification for a high-precision measurement of A_γ in the FP-12 cave. However it seems acceptable for the planned reduced-sensitivity measurement and should not impede progress toward this goal.

The LH_2 target has been constructed, tested with liquid nitrogen, and delivered to LANL. Significant work remains before the target can be operated for the physics measurement on FP-12. Safety reviews and operator training plans must be designed and implemented for both shed and ER-2 operation. Hydrogen relief and vent lines must be designed and installed in the shed and ER-2. The collaboration presented a plan for this work, and all required testing, to be completed prior to the scheduled FP-12 beam availability in July-Sept 2005. This is an extremely aggressive plan and is probably not realistic.

Reviewer:

The good news is the beam line project has been successfully completed. The bad news is that for various reasons, some due to over optimistic early projections, some still not understood, the neutron flux is substantial down from the original proposal. Understanding these differences should be important to the SNS source designers, but for the collaboration, it's time to move on and make measurements as best they can.

The commissioning run in 2004 was very successful. It succeeded in testing all components with the important exception of the hydrogen target itself. A set of measurements established limits on parity violating and parity conserving false asymmetries from neutrons interacting with the materials of the target. An indication of the power of the apparatus is that a 10% measurement of parity violation in Cl was made in just one eight hour shift.

The field from the magnet on neighboring beam line FP11 was found to exceed the proposed specifications even after substantial efforts in building active and passive shielding. The impact of these residual fields may not be as critical as once thought however since the f_π precision they propose aiming for is now at the level of 5×10^{-7} rather than 0.5×10^{-7}

The hydrogen target installation has experienced significant delays. Given that the target vessel, the refrigerators, and the gas manifold systems were delivered to LANSCE in 2003, this has been hard to understand. The target appears to be well designed, well constructed, carefully assembled, and ready to go. But it sat for many months untouched, and is yet to be filled with liquid hydrogen. Setting the safety review schedule for moving forward to installation on the flight path will require significant help from LANSCE and P division management, possibly also including technical support to install the vent stacks from ER-2.

Reviewer:

With the notable exception of the LH2 target, all construction related tasks seem to be complete. A successful commissioning run, without the LH2 target, was completed in 2004. Overall the systems performed well, albeit with the now expected reduced number of neutrons. Several useful calibration and systematic studies were completed.

The LH2 target was sent to LANL in 2003 and has now been assembled in a nearby shed area. It has still never been operated with hydrogen. The plan is to first operate it in the shed, then relocate it to the experimental cave. We were told that they are ready to introduce hydrogen, once all requisite safety reviews have been completed. There may be additional and considerable delays related to the recent management changes on how operations are conducted at LANL. It was very puzzling that the collaboration seemed unaware that other hydrogen targets have been successfully operated at LANSCE. They should absolutely be tapping into these knowledgeable experts who have successfully navigated the safety review process. LANSCE leadership indicated a willingness to work with the collaboration in this area.

The problem with magnetic interference from the nearby FP11A superconducting magnet has now been studied. It was found that even with the installed compensation coils, there will be problems with the magnetic field leakage into the $np \rightarrow d\gamma$ target area. The collaboration has concluded they will need to run with the administrative mode option, where they take physics data when the magnet is off. One problem that became clear during the discussions was that the collaboration was still using the same acceptance

criteria that were needed with their original 5 x 10^{-9} sensitivity goal. With their expected reduced sensitivity, it is likely they can acquire data with slightly relaxed acceptance requirements. A slightly different concern that the collaboration does not seemed to have carefully considered is the potential problem with magnetization of materials in the floor and surrounding area from the long term running of the FP11A magnet. This is something they should monitor both before, during, and after any running. If the collaboration was ready at the start of the run period, it would likely be better to take $np \rightarrow d\gamma$ first, before the magnet has run and potentially introduced time dependent magnetization effects.

The past several years LANSCE has improved its operations record, and expects to deliver the expected beam on target for the upcoming beam cycle.

The feasibility and completeness of the budgets and schedules:

Reviewer:

As noted above, the experiment has undergone significant delays and cost overruns. All capital funds for the project have been spent so remaining tasks are being supported from laboratory LDRD funds and operations. This puts the experiment in a tenuous position. If a system failure occurs, there are no resources readily available to repair or replace failed components. A major component of the project, the LH_2 target, has yet to be commissioned. The target was delivered to LANL over a year ago. To date, very little has been done to commission it. If major costs arise in the work leading up to target commissioning, it will severely strain the available resources.

A target commissioning schedule was put forward at the technical review that appeared to be completely unrealistic given the present status of the target. A more realistic, but still aggressive, schedule would allow for the target to undergo commissioning in the latter part of the '05 run cycle. This will only be accomplished if LANSCE and P-division management work closely with the collaboration to insure no undue delays occur. It is imperative that the collaboration complete target commissioning in '05 and be prepared for a long run in '06. If this does not happen, the experiment will be compromised and may not achieve even its reduced goal at LANSCE. This could have disastrous consequences for the collaboration.

The collaboration did not provide a detailed run plan for the experiment. It appears that recent efforts have been focused on completing the target and moving the experiment rather than running it a LANSCE. The collaboration should be encouraged to develop a run plan and, at a minimum, present it to P-division management.

Reviewer:

Except for the LH_2 target, all work packages for both the beam line and the experiment are complete. Satisfactory operation of the beam line has been demonstrated, although the delivered neutron flux is substantially below the expected flux. Some components of

the experiment have not yet achieved their proposed performance specifications, but are close enough to be considered effectively compete with minor modifications needed. The LH_2 target was planned for completion in June 2003. It is not yet complete; a lot work remains to be done.

Most work packages were completed past their due date, in many cases 1–2 years overdue. The experiment is over budget. Previous and continuing cost overruns are met by using LANL LDRD funds.

Reviewer:

A schedule with a run including the hydrogen target is realistic if all parties cooperate to carry out the safety review in a timely fashion, and complete the infrastructure work. But at LANL at the present time, there appear to be many factors out of the control of the experimenters and even management. A more realistic schedule probably has a test run in the upcoming cycle, and a full run in the following run cycle.

As long as there are no major problems with the target, the budgets as presented appear reasonable to complete the experimental phase of the project (at reduced sensitivity as noted earlier).

Reviewer:

Unfortunately the experiment continues to fall far behind schedule, and there have been additional budget overruns that will be covered by LANL. The schedule is still optimistic, in particular considering the LANL staffing projections, which are very low. This seems to be a systemic problem at LANL – laboratory staff that are spread too thin working on multiple projects that are under funded.

The schedule delays on the H_2 target, have now put the experiment in the worst possible situation, where the FP11 magnet will be running first.

The largest schedule risk is approval, installation, and operation of the LH target. If the schedule slips, it is probable that the physics run will not occur until the subsequent run cycle. It is not clear there are sufficient people to both prepare for the upcoming run and to field the H2 target.

The long delay in bringing this experiment into operation has presented a challenge to the collaboration in that younger members have moved on to other projects. Furthermore, there is a concern that they have also lost and not replaced senior members, such as Kevin Coulter, and will likely have reduced time from Scott Wilburn, who played a pivotal role in the construction phase, and is now moving into a management position.

The effectiveness of the management structures:

Reviewer:

The management team is to be congratulated on the successful commissioning run that was carried out in '04. But several issues were uncovered which need to be addressed.

It was not clear if plans presented by project management (in particular, a schedule for the target commissioning and a possible move to HIFR) had been discussed thoroughly with the collaboration and with P-division and LANSCE management prior to the technical review. In particular, the target commissioning plan counts heavily on help from LANSCE to prepare the hall for the target and to obtain the necessary safety approvals to operate the target. The schedule was generally regarded as unrealistic by the outside review team. Given the significant schedule slippages that have occurred in the past, management should strive to develop realistic schedules for future commissioning and running.

Several key members of the collaboration have either left or moved to administrative positions. The collaboration management should be actively seeking help to replace these important team members.

The management team did not specify who would be in charge of target commissioning in the upcoming run. Also no one was identified as the run coordinator nor was anyone identified to lead the analysis effort. These are all key positions at this point in time and the players need to be identified so that they can organize these activities. In general the management team did not seem to have a model for how the effort would evolve from a construction project to an experiment. Since this transition should (begin to) occur in '05, it is imperative that the collaboration develop a plan for this transition.

Overall it is clear that P-division and LANSCE management must work closely with the collaboration management team to keep this experiment from failing. It is at a critical juncture where further delays or problems could cause it to fail.

Reviewer:

Project management has been very effective in marshalling the intellectual capacity of a large and disparate collaboration to develop and construct components for an experiment to isolate and measure an extremely small quantity. A variety of systematic effects were considered and properly analyzed, and components were designed and integrated to carefully control them. The success of this effort was demonstrated in the 2004 commissioning run. The apparatus will probably be capable of a measurement of A_γ at the design precision of 5×10^{-9} when installed on a sufficiently intense pulsed neutron beam.

Project management has been ineffective in developing and keeping to realistic schedules. It may be that previous overoptimistic schedules were used as motivators

rather than effective management tools, and as such the schedules were not taken seriously by collaborators. The project has been behind schedule and over budget for the past several years. The schedule for 2005 presented at the review is similarly overoptimistic. To bring this project to a successful conclusion, project management must abolish this practice and begin to develop and maintain effective schedules.

The project suffers from a lack of good communication between the collaboration, P Division, and LANSCE management. For example, serious misunderstandings about defining and developing safety and training plans for the LH_2 target and scheduling work in ER-2 were evident during this review. Better communication and coordination between these units will be essential to complete the project and first physics run efficiently and on a reasonable schedule.

Reviewer:

The team did a superb job in pulling together and pulling off a successful commissioning run. To the outside, it does appear that distractions associated with the proposed move to HIFR, and questions of how to deal with the nearby magnetic field, may have lead to a loss of focus regarding preparation of the hydrogen target. It will be important to have full input from the outside users as the project moves into the final critical phases. It wasn't clear how often there were npdγ conference calls between the major parties involved. UCNA appears to be teleconferencing regularly once a week, and the level of day-to-day participation from outside seems stronger. In any case, the offer of cost and scheduling support from physics division management should be acted on positively.

Reviewer:

Given the challenges the collaboration has faced in fielding this experiment, Seppo Pentilla, should be recognized and praised for his work as project manager.

The dedication of resources and time to the consideration of moving the detector to HIFR seems at this stage of the experiment to be a serious misjudgment by the experiment's leadership. Given the upcoming challenges and the need to demonstrate at LANL that the apparatus will work, the collaboration's executive committee needs to be very actively engaged in providing guidance and direction.

Plans for commissioning and operation:

Reviewer:

As noted above, the plans for target commissioning were considered unrealistic. Furthermore there were no plans presented for running the experiment. The review committee was told the number of shifts that needed to be manned and were assured that the manpower to do this was available. But an actual run plan was not presented.

Reviewer:

The plan presented by the collaboration to finish the LH_2 target in time for operation during the beam availability of July 2005 is overly optimistic. It seems unrealistic, especially considering the previous pattern of schedule slippages and the additional obstacles created by the LANL shutdown in summer 2004. A better plan would be to complete and test the target in 2005 and proceed with the first physics measurement in 2006.

A run plan for the physics measurement was not presented. A detailed plan that indicates data collection periods, systematics measurements, and calibrations; and specifies running configurations and manpower requirements; is needed. A run coordinator should be appointed.

Several key personnel have recently left the project or taken another position that will change their contribution level. The collaboration list presented at the review did not adequately reflect this, or demonstrate that sufficient personnel are available for 2005-2006 operations. A current review of collaboration membership and commitments for future operations is needed.

Reviewer:

No detailed run plan was presented. The collaboration needs to plan carefully how they will split their time between data taking, calibrations, and systematic studies. They need a run manager to coordinate these efforts.

Other issues related to the neutron experiments and their experimental program:

Reviewer:

It will be a real loss to physics if LANSCE and P division don't work together to make this experiment happen in the next 12 months. I think they understand the urgency of the situation, but the community will need to see concrete results very soon, not just talk, to really be convinced that the situation is under control.